



Lesson Plan: Chemical bonding

Grade Level: 8

Subject: Physical Science

Duration: 45–60 min

NGSS MS-PS1-1: Develop models to describe the atomic composition of simple molecules and extended structures.

Learning Objectives

By the end of this lesson, students will be able to:

- **Describe** how valence electrons and the need for eight outer electrons (two for hydrogen) lead atoms to form chemical bonds.
- **Distinguish** ionic, covalent, and metallic bonds by whether valence electrons are



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becomes a negatively charged ion, and the attraction between these opposite charges holds them together, as in sodium chloride (table salt).

- **Covalent bond:** A bond formed when two atoms share valence electrons instead of transferring them. Covalent bonds usually form between two nonmetals, such as the hydrogen and oxygen atoms in water.
- **Metallic bond:** The force of attraction that holds the atoms of a metal together. Metal atoms give up their valence electrons, which move freely among the positive metal ions; this is why metals bend without breaking, shine, and conduct heat and electricity well.



- **Molecule:** The smallest unit of a substance formed when two or more atoms join together by covalent bonds. A water molecule (H_2O) has two hydrogen atoms and one oxygen atom; an oxygen molecule (O_2) has two oxygen atoms.
- **Compound:** A substance made of two or more different elements that are chemically bonded together in a fixed ratio. Water (H_2O) and sodium chloride (NaCl) are both compounds, and each always has the same ratio of atoms.
- **Chemical formula:** A way of writing a substance with element symbols and small numbers (subscripts) that show how many atoms of each element it contains. AlCl_3 has one aluminum atom and three chlorine atoms; a large number in front, as in 2NaBr , tells how many units there are.
- **Polarity:** An uneven spread of electric charge in a molecule, caused when one atom pulls the shared electrons of a covalent bond more strongly than the other atom does. In water, the oxygen end is slightly negative and the hydrogen ends are slightly positive, so water molecules attract one another.



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- Ball-and-stick molecular model kits (one per pair) with enough hydrogen, carbon, and oxygen pieces to build H_2O , CO_2 , and C_3H_8
- Water, a dropper, and a sheet of wax paper for the water-polarity droplet demonstration
- Periodic table reference sheet showing atomic numbers and atomic masses

Lesson Procedure

Step 1: Introduction (5 minutes)



- Ask: "Table salt is made of only sodium and chlorine, and water of only hydrogen and oxygen. What holds those atoms together, and why is salt a hard crystal while water is a liquid?"
- Pass around table salt grains with a hand lens so students see the repeating cube-shaped crystals that form when sodium and chlorine bond.
- State the key idea from the Study Guide: bonding uses only an atom's outermost (valence) electrons, and atoms bond to reach eight outer electrons, like the noble gases already have (hydrogen needs only two). (<https://newpathworksheets.com/api/guide/study-guide-science-grade-8-chemical-bonding.pdf>)

Step 2: Direct Instruction (15 minutes)

- Use the Study Guide's electron dot diagram (dots around an element symbol stand for valence electrons) to show sodium giving its one valence electron to chlorine, which had seven; both now have eight outer electrons, become oppositely charged ions, and attract to form an ionic bond in sodium chloride. (<https://newpathworksheets.com/api/guide/study-guide-science-grade-8-chemical-bonding.pdf>)



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each model.

- Complete Vocabulary Worksheet 1 together, matching ionic bond, covalent bond, metallic bond, molecule, compound, chemical formula, molecular mass, and polarity to their definitions. Teaching note: item 8 describes polarity as the force that causes unequal sharing; point out that polarity is the result of electrons being shared unequally. Items 2 and 7 describe a compound as a molecule and a molecule as a unit of an element; explain that a molecule can be an element (O₂) or a compound (H₂O), and that ionic compounds such as sodium chloride form crystals of ions rather than molecules.



(<https://newpathworksheets.com/api/vocabulary/vocabulary-science-grade-8-chemical-bonding-1.pdf>)

- Work Practice Worksheet 0 items 1-6 as a class: identify the bond type in the carbon dioxide and sodium chloride dot diagrams and name the bond that holds a group of active metal atoms together. (<https://newpathworksheets.com/api/worksheet/worksheet-science-grade-8-chemical-bonding-0.pdf>)

Step 4: Independent Practice (12 minutes)

- Students finish Practice Worksheet 0 items 7-10 on their own: read the formula $AlCl_3$, count its atoms, name aluminum chloride, and write the formula for two units of sodium bromide. Teaching note: item 10 here and Practice Worksheet 1, item 1, ask for two molecules of sodium bromide; accept $2NaBr$ and explain that sodium bromide is an ionic compound, so two units describes it more precisely.

(<https://newpathworksheets.com/api/worksheet/worksheet-science-grade-8-chemical-bonding-0.pdf>)

- Students complete Practice Worksheet 1: count atoms in $AlCl_3$ and $Al_2(SO_4)_3$, name K_2O



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transferred, free to move, or shared.

Differentiation Strategies

For advanced learners:

- Have students draw electron dot diagrams for magnesium oxide (MgO) and methane (CH_4), predict whether each bond is ionic or covalent, and add the atomic masses for $Al_2(SO_4)_3$ using the periodic table reference sheet.



- Challenge students to explain why sodium chloride forms a repeating crystal of ions rather than separate molecules, using the salt grains seen under the hand lens as evidence.

For learners needing support:

- Provide a desk-size chart of the first 20 elements showing each element's valence electrons as dots, so students can read off the electron dot diagrams for sodium, chlorine, hydrogen, oxygen, and carbon.
- Give students pre-built ball-and-stick models of water and carbon dioxide to hold while they count atoms and match each model to its chemical formula.

Extension Activities

- Build a simple conductivity tester from a battery, a small bulb, and wires, then test copper wire, aluminum foil, dry table salt, and salt water; relate the results to the moving electrons



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- Worksheet PDF 1 (<https://newpathworksheets.com/api/worksheet/worksheet-science-grade-8-chemical-bonding-1.pdf>)
- Worksheet PDF 2 (<https://newpathworksheets.com/api/worksheet/worksheet-science-grade-8-chemical-bonding-2.pdf>)
- Vocabulary PDF 1 (<https://newpathworksheets.com/api/vocabulary/vocabulary-science-grade-8-chemical-bonding-1.pdf>)

CHEMICAL BONDING

Chemical bonding involves only an atom's outermost electrons. These electrons are called **valence electrons** and because they have more energy than other electrons, they tend to be found further away from the nucleus.

Since the valence electrons are the atom's most important electrons, electron dot diagrams are drawn to show them.

***Lesson Checkpoint:**
What are valence electrons?*

Achieving Stability

Individual atoms seek stability. This occurs when the outermost orbit



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The result of this bond is an ionic **compound**. **Ions** are electrically charged atoms and, in this case, Na having given up one electron becomes positively charged and Cl, now having an extra electron, becomes negatively charged. The force of attraction between these two ions creates the bond.

***Lesson Checkpoint:**
What is an ionic bond?*

- The second type of bonding is called **covalent bonding**. With this bond, atoms do not transfer their valence electrons but, instead, a sharing of valence electrons takes place. If you look at the electron dot diagram below, Hydrogen needs to get two electrons to bond and Oxygen needs eight. To achieve this, each Hydrogen atom shares one electron with Oxygen and Oxygen, in turn, shares one of its valence electrons with each Hydrogen atom. The result is the formation of a **water molecule**. A molecule forms when covalent bonds are used.



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what properties do they give to metal atoms?

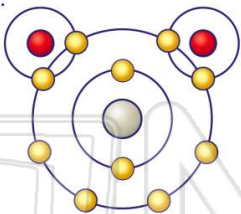


Name _____ Class _____ Date _____

1

A **covalent bond** usually forms **between** _____.

- A two metals
- B two metalloids
- C a metal and a nonmetal
- D two nonmetals



2

Using the **electron dot diagram** below, determine what kind of **bond** has formed between the carbon atom and the two oxygen atoms.

- A metallic
- B covalent
- C ionic
- D molecular



3

Using this diagram of carbon dioxide, determine how many **valence electrons** each **oxygen** atom has after bonding with the carbon atom.

- A 8
- B 6



4

In the diagram below, one **sodium** atom has bonded to one **chlorine** atom. What type of **bond** has formed between these two atoms?

- A metallic
- B covalent



5



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9

The name of the compound shown in the **chemical formula** below is _____.

- A aluminum chlorine
- B chlorine aluminide
- C aluminum chloride
- D chloroaluminum



10

What is the **correct** formula for **two** molecules of sodium bromide?

- A NaBrx2
- B 2NaBr
- C NaBr2
- D 2xNaBr



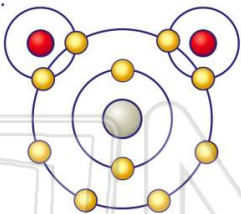


Name _____ Class _____ Date _____

1

A **covalent bond** usually forms **between** _____.

- A two metals
- B two metalloids
- C a metal and a nonmetal
- D two nonmetals



D

2

Using the **electron dot diagram** below, determine what kind of **bond** has formed between the carbon atom and the two oxygen atoms.

- A metallic
- B covalent
- C ionic
- D molecular



B

3

Using this diagram of carbon dioxide, determine how many **valence electrons** each **oxygen** atom has after bonding with the carbon atom.

- A 8
- B 6



A

4

In the diagram below, one **sodium** atom has bonded to one **chlorine** atom. What type of **bond** has formed between these two atoms?

- A metallic
- B covalent



C

5



C

7

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D

9

The name of the compound shown in the **chemical formula** below is _____.

- A aluminum chlorine
- B chlorine aluminide
- C aluminum chloride
- D chloroaluminum



C

10

What is the **correct** formula for **two** molecules of sodium bromide?

- A NaBrx2
- B 2NaBr
- C NaBr2
- D 2xNaBr



B



Name _____ Class _____ Date _____

1

What is the **correct** formula for **two** molecules of sodium bromide?

- A NaBrx2
- B 2NaBr
- C NaBr2
- D 2xNaBr

**2**

How many **atoms** are there in **two molecules** of the compound shown below?

- A 4
- B 1
- C 8
- D 2

**3**

What is the **molecular mass** of the compound shown below?

- A 16 grams
- B 78 grams
- C 32 grams
- D 94 grams

**4**

The **name** of the compound shown below is _____.

- A potassium oxide
- B potassium dioxide
- C dipotassium oxide
- D potassium oxygen

**5**

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9

What is the total **number of atoms** in the chemical formula shown below?

- A 17
- B 15
- C 10
- D 5

**10**

How many atoms of **oxygen (O)** are in the **chemical formula** below?

- A 4
- B 5
- C 7
- D 12





Name _____ Class _____ Date _____

1

What is the **correct** formula for **two** molecules of sodium bromide?

- A NaBrx2
- B 2NaBr
- C NaBr2
- D 2xNaBr



(B)

2

How many **atoms** are there in **two molecules** of the compound shown below?

- A 4
- B 1
- C 8
- D 2



(A)

3

What is the **molecular mass** of the compound shown below?

- A 16 grams
- B 78 grams
- C 32 grams
- D 94 grams



(D)

4

The **name** of the compound shown below is _____.

- A potassium oxide
- B potassium dioxide
- C dipotassium oxide
- D potassium oxygen



(A)

5



(A)

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(B)

9

What is the total **number of atoms** in the chemical formula shown below?

- A 17
- B 15
- C 10
- D 5



(A)

10

How many atoms of **oxygen (O)** are in the **chemical formula** below?

- A 4
- B 5
- C 7
- D 12



(D)



Name _____ Class _____ Date _____

- 1 How many atoms of **oxygen (O)** are in the **chemical formula** below?

A 4
B 5
C 7
D 12

$\text{Al}_2(\text{SO}_4)_3$

- 2 The diagram shown below is a **structural formula** for the gas **propane**. What would be the correct **chemical formula** for propane?

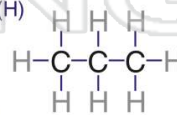
A C_3H_8
B CH_8
C $8\text{H}_3\text{C}$
D CH

- 3 Carbon (C) and hydrogen (H) create **covalent bonds** to share **electrons** between them. What is the total number of electrons being shared between **carbon** and **hydrogen** in the molecule of propane shown below?



- 4 The **reason** why the bonds between carbon (C) and hydrogen (H) are **covalent** is _____.

A C and H do not have electrons to give away
B C and H are both nonmetals



5



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- B water boils easily
C ice melts easily
D water has color



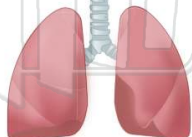
- C solvent
D magnet



9

- The chemical formula for the **oxygen** that we breathe is _____.

A O
B O_2
C O_4
D 20



10

- How many **molecules of oxygen** are represented in the chemical formula below?

A 2
B 4
C 6
D 18





Name _____ Class _____ Date _____

- 1 How many atoms of **oxygen (O)** are in the **chemical formula** below?

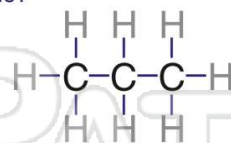
A 4
B 5
C 7
D 12



(D)

- 2 The diagram shown below is a **structural formula** for the gas **propane**. What would be the correct **chemical formula** for propane?

A C_3H_8
B CH_8
C $8\text{H}_3\text{C}$
D CH



(A)

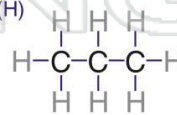
- 3 Carbon (C) and hydrogen (H) create **covalent bonds** to share **electrons** between them. What is the total number of electrons being shared between **carbon** and **hydrogen** in the molecule of propane shown below?



(C)

- 4 The **reason** why the bonds between carbon (C) and hydrogen (H) are **covalent** is _____.

A C and H do not have electrons to give away
B C and H are both nonmetals



(D)

5



(C)

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(C)

B water boils easily
C ice melts easily
D water has color

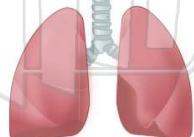


C solvent
D magnet



- 9 The chemical formula for the **oxygen** that we breathe is _____.

A O
B O_2
C O_4
D 20



(B)

- 10 How many **molecules of oxygen** are represented in the chemical formula below?

A 2
B 4
C 6
D 18



(B)



Name _____ Class _____ Date _____

Match each of the following terms to its definition:

Ionic bond

Molecular mass

Compound

Chemical formula

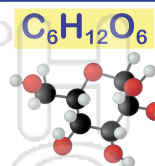
Polarity

Covalent bond

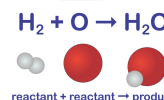
Molecule

Metallic bond

1. _____ - a formula using symbols, that shows the number of each kind of atom in a molecule



2. _____ - a molecule made up of two or more different elements that are chemically combined



3. _____



4. _____

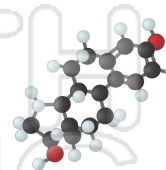
5. _____

6. _____

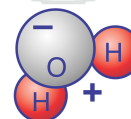
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7. _____ - the smallest unit of an element formed when two or more atoms join together chemically; the chemical combination of at least two atoms



8. _____ - the force that causes an unequal sharing of electrons in some covalent bonds





Name _____ Class _____ Date _____

Match each of the following terms to its definition:

Ionic bond

Molecular mass

Compound

Chemical formula

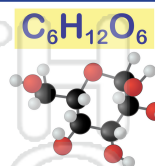
Polarity

Covalent bond

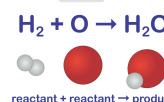
Molecule

Metallic bond

1. chemical formula - a formula using symbols, that shows the number of each kind of atom in a molecule



2. compound - a molecule made up of two or more different elements that are chemically combined



3. cov
electr

4. ion
electr

5. me
metal

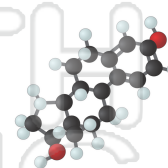
6. mo



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7. molecule - the smallest unit of an element formed when two or more atoms join together chemically; the chemical combination of at least two atoms



8. polarity - the force that causes an unequal sharing of electrons in some covalent bonds

